



The First Electric Power Transmission Line in North America—Oregon City, Oregon

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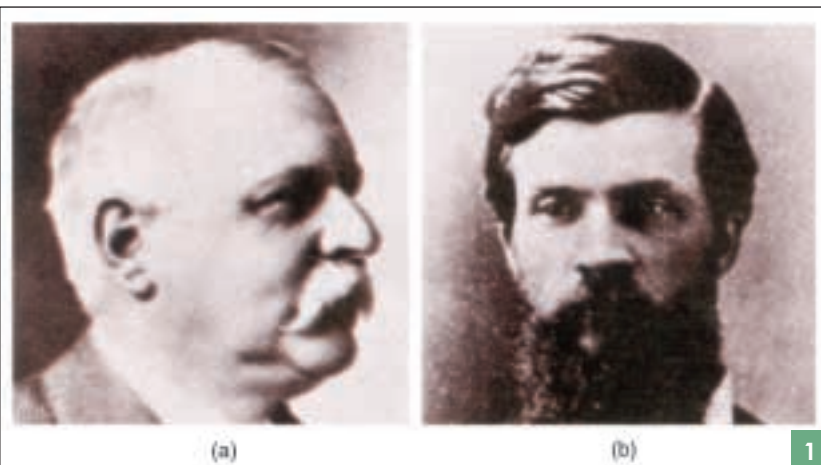
In the 1800s, the development of the incandescent electric light bulb by Edison and others and the invention of dc and ac motors by Gramme and Tesla led to the commercial use of larger and larger amounts of electric power in the United States. Every year since, the demand for electric power has shown dramatic increases.

The uses of electric power are rarely at the locations where electric power is generated. Thus, there is a need to transmit electric power from its sources to the points of utilization. Perhaps the most important way this is done is by overhead electric power transmission lines. Where was the first such transmission? Some sources indicate it was in 1886 at Cherchi, Italy, where energy was transmitted to Rome over a distance of 17 miles [1]. Little information is available on this installation.

Much more is known of the first electric power transmission line in North America. It was constructed in 1889 between the generating station at Willamette Falls in Oregon City, Oregon, and downtown Portland, Oregon, a distance of around 13 miles. Although the distance of 13 miles is very short compared to the length of present transmission lines, its construction and successful operation was considered to be a major technological breakthrough at the time [1], [2], [6], [7].

To put this in some kind of an electrical engineering time frame, note the following chronology of American hydroelectric development [2]:

- 1879—Cleveland, Ohio: the first commercial arc lighting system is installed
- 1879—Menlo Park, New Jersey: Thomas Edison demonstrates incandescent lamps
- 1881—Niagara Falls, New York: a brush dynamo connected to a turbine in Quigley's flour mill lights city street lamps
- 1882—Appleton, Wisconsin: the Vulcan Street Plant is the first hydroelectric station to use Edison's system
- 1883—Edison introduces the "three-wire" transmission system
- 1886—Westinghouse Electric Company is organized
- 1886—the first American transformer is built and demonstrates the use of step-up and step-down transformers for long-distance ac power transmission
- 1888—the rotating field ac alternator is invented
- 1889—Oregon City, Oregon: Willamette Falls Station becomes the first ac hydroelectric plant. Single-phase power is transmitted 13 miles to Portland at 4,000 V stepped down to 50 V for distribution



(a) P.F. Morey and (b) E.L. Eastham [3].



Station A exterior [3].

- 1891—Ames, Colorado: a Westinghouse alternator is driven by a Pelton waterwheel, 320-ft head. Single-phase, 3,000-V, 133-cycle power is transmitted 2.6 miles to drive ore stamps at Gold King Mine
- 1891—the 60-cycle ac system is introduced in the United States
- 1892—the General Electric Company is formed by a merger of Thomson-Houston and Edison General Electric
- 1893—Mill Creek, California: the first American three-phase hydroelectric plant. Power is carried eight miles to Redlands on a 2,400-V line.

Oregon City, Oregon, is generally recognized as the western end of the Oregon Trail, the route followed by many wagon trains bringing many migrants to the Pacific Northwest. Oregon City is on the banks of the Willamette River at the location of Willamette Falls. The Willamette River is a major tributary to the Columbia River. The water power available here was self-evident to early settlers. In the early 1800s, prior to electric power generation here, several mills of different types were built utilizing water power. Included were saw mills, grist mills, woolen mills, flour mills, and paper mills.

On 2 May 1884, Swiss engineer P. Miescher had issued a report on the

power possibilities of Willamette Falls [1], [3]. His report suggested four different methods by which power from the falls might be transmitted for some distance:

- 1) water of high pressure
- 2) compressed air
- 3) electricity
- 4) wire rope.

Miescher's comments on wire rope transmission are interesting: "The cheapest and most effective way to transmit hundreds of horsepower from one place to another is by means of endless wire ropes running over large pulleys." A Portland General

Electric Company historian commented, "Mr Miescher was a brilliant engineer, but time has proven some of his conclusions were not well founded."

Miescher's report continued,

The electrical transmission of power for manufacturing purposes is yet in its infancy, but is promising a rapid development. Two dynamo machines are needed, connected by a strong isolated wire or cable. The first one gets the power of the turbine wheel and transforms it into electrical current, and the second one gets the current from the cable, transforms it into power again, and drives the main shaft of the mill or factory. From 45 to 60% of the original power taken at the shaft of the turbine wheel may be realized at the other end of the cable several miles distant, and it is only the cost of such a cable of sufficient size that limits the distance to which power may be transmitted, because not only the length is double for the distance, the section of the conducting wire has to be twice as large at the same time to produce the same effect.

The great advantage of this kind of transmission (electrical) is that it does not matter at all what position to each other the two ends have, while water transmission



Illustration of Station A and transmission line painted by BPA engineer [6].

gives only a good effect where the mill or factory is nearly on the same level or lower than the original water wheel.

No experience has yet been made with very large (electrical system) dimensions, and it may take a very long time before hundreds of horsepower can be transmitted with safety.

Much of the credit for the first hydroelectric power generation in Oregon and the first electrical transmission line in America goes to P.F. Morey and E.L. Eastham (Figure 1), who incorporated the Willamette Falls Electric Company on 8 November 1888. The two had long believed that it was possible to use the water power at the Oregon City Falls to supply electric power to the City of Portland and the surrounding territory.

The Willamette Falls Company proceeded at once to build the electric power transmission line and dynamo house, Station A (Figures 2 and 3), on the east side of the river. Dynamos were moved there from a Portland sawmill. They were belt-driven from a horizontal line shaft connected to the vertical turbine shaft (Figure 4). Though there is some conflict in different references, it appears that these first units and the first transmission line were dc. The streets of Portland were first lighted by electricity from Oregon City in early June of 1889. This event was described in the 3 June 1889 issue of the Portland newspaper the *Morning Oregonian*, [1], [3], [5]:

The Willamette Falls Electric Company started up one of their Brush arc dynamos last evening, and the electricity was sent from Oregon City for lighting one of their 10 o'clock circuits in this city. It worked magnificently, and conclusively demonstrated the fact that our city can be lighted successfully from the falls. The result was a pleasing surprise to the company, the percentage of loss of electricity by transmission being a lot less than their most sanguine expectations. The work of removing the machinery from the station here to the falls will be carried on as expeditiously as possible.

THE WILLAMETTE FALLS ELECTRIC COMPANY WAS THE FIRST U.S. CENTRAL STATION TO ENGAGE IN LONG DISTANCE TRANSMISSION OF ELECTRIC ENERGY.

Another large dynamo will be moved up today.

Morey and his consulting engineer, W.C. Cheney, were convinced that generation of electricity at a higher voltage than was then utilized was possible and insisted that alternating current generators be built. The newness of this approach is evidenced by the difficulty encountered in obtaining such dynamos. Finally, Westinghouse Electric and Manufacturing Company agreed to build them, but with the "express condition that the

company was not to be held responsible for and would not undertake to guarantee satisfactory operation of such generators."

Shortly thereafter, the dc generators were replaced with six Westinghouse single-phase ac units rated 80 kW (1,600 lights), 125 cycle, 4,000 V. Subsequently, two 120-kW, 125-cycle, single-phase 2,000-V Thomson-Houston generators were added, with the voltage being stepped up by means of air blast transformers to 4,000 V.

No record of the exact date of the first transmission of ac from the Oregon City plant to Portland has been found, but it was probably in the summer of 1890. Other early ac transmission lines were those of the Telluride Mining Company in southwestern Colorado, in 1891, at 3,000 V for three miles, and the San Antonio Light and Power Company in California over two lines, one in 1892 over 14 miles to Pomona, initially at 5,000 V, and then after the system was increased to 11,000 V, a 28-mile extension to within a year to San Bernadino [2], [4], [7].

In this early period, the art of transmission was very new. It was recognized that ac generators driven by independent prime movers could be made to operate in parallel under



Station A interior [3].

suitable conditions, and it had actually been done in an experimental way, but suitable apparatus to enable it to be done in a practical way had not yet been devised. Therefore, in the beginning, each generator in the Oregon City plant supplied electricity to an individual two-wire circuit. This resulted in the electric transmission of that day being made up of a large number of wires. As many as 16 circuits, or 32 wires, were carried by the Oregon City-Portland transmission line in the later years of the early period of its operation [1].

Based on the foregoing, to the Willamette Falls Electric Company, a predecessor of the present Portland General Electric Company, goes the

honor of being the first central station in the United States to engage in long distance transmission of electric energy, both ac and dc, for commercial purposes.

References

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